

What is claimed is:

1 1. A distortion compensation method comprising:

2 determining an undisturbed phase for at least one of a
3 first position indication signal and a second position
4 indication signal;

5 determining an undisturbed ratio that relates the
6 amplitude of the first position indication signal at a first
7 frequency to the amplitude of the second position indication
8 signal at a second frequency;

9 determining a disturbed amplitude and phase of the
10 position indication signal; and

11 adjusting a position indication based on the disturbed
12 amplitude and phase, the undisturbed amplitude ratio, and the
13 undisturbed phase.

1 2. The method of claim 1 further comprising calculating
2 a relationship between the eddy current phases of the first
3 position indication signal and the second position indication
4 signal.

1 3. The method of claim 1 further comprising:

2 determining a second undisturbed ratio that relates the
3 amplitude of either of the first and the second position
4 indication signals to the amplitude of a third position
5 indication signal at a third frequency, and

6 adjusting a position indication is further based on the
7 second undisturbed ratio.

1 4. The method of claim 1 wherein the first frequency is
2 a superior harmonic of the second position indication signal
3 and the second frequency is a subordinate harmonic of the
4 first position indication signal.

1 5. The method of claim 4 wherein the superior harmonic
2 is the fundamental frequency.

1 6. The method of claim 4 wherein the subordinate
2 harmonic is a third order harmonic.

1 7. The method of claim 1 wherein the first frequency is
2 less than the second frequency.

1 8. The method of claim 1 further comprising generating a
2 plurality of frequencies using a multiple frequency waveform.

1 9. The method of claim 8 wherein the multiple frequency
2 waveform is a chirped waveform.

1 10. The method of claim 1 wherein the selected first
2 frequency and second frequency are harmonically related.

1 11. The method of claim 1 wherein the distortion
2 compensation method is repeated for a plurality of position
3 indication signals.

1 12. The method of claim 1 further comprising detecting
2 the presence of an eddy current in a conductive object.

1 13. The method of claim 12 wherein detecting the
2 presence of an eddy current includes monitoring a ratio of the
3 amplitude of the first position indication signal and the
4 amplitude of the second position indication signal.

1 14. The method of claim 12 wherein detecting the
2 presence of an eddy current includes detecting a change in the
3 undisturbed phase.

1 15. The method of claim 1 wherein determining the
2 undisturbed phase includes measuring asymptotic phase values
3 and using the asymptotic phase values to calculate the
4 undisturbed phase.

1 16. The method of claim 15 wherein determining the
2 undisturbed phase includes iteratively calculating phase
3 values and adjusting an asymptotic phase value, the asymptotic
4 phase value used to calculate the undisturbed phase.

1 17. The method of claim 1 further comprising receiving
2 from a sensor the real and imaginary components of the first
3 and second position indication signals.

1 18. A distortion compensation method comprising:
2 determining a characteristic mathematical formulation
3 that describes an undistorted frequency function;
4 monitoring the characteristics of the mathematical
5 formulation to indicate the presence of conductive objects;
6 and
7 adjusting the characteristic mathematical formulation to
8 compensate for distortions of a disturbed frequency function.

1 19. The method of claim 18 wherein monitoring the
2 characteristics of the mathematical formulation includes
3 monitoring the characteristics of the mathematical formulation
4 in subsequent real-time measurements.

1 20. The method of claim 18 wherein the mathematical
2 formulation is a complex polynomial function.

1 21. The method of claim 18 wherein the disturbed
2 frequency function describes real and imaginary components of
3 the position indication signal.

1 22. The method of claim 18 wherein the disturbed frequency
2 function describes the amplitude and phase of the position
3 indication signal.

1 23. A method for detecting the presence of conductive
2 objects, the method comprising:

3 determining a characteristic frequency function of an
4 undisturbed magnetic tracking system;

5 measuring a disturbed real-time frequency function;

6 calculating real and imaginary components of the position
7 indication signal using a chi-squared minimization of the
8 disturbed frequency function to the undisturbed frequency
9 function;

10 calculating a chi-squared value based on the
11 characteristic frequency function and the disturbed frequency
12 function; and

13 monitoring the chi-squared value to detect changes
14 indicating the presence of a conductive object.

1 24. The method of claim 23 wherein determining the
2 characteristic frequency function includes determining the
3 characteristic frequency function based on undisturbed
4 position indication signals.

1 25. The method of claim 23 further comprising monitoring
2 the chi-squared value for a plurality of position indication
3 signals.

1 26. The method of claim 25 wherein detecting a change in
2 the chi-squared value of at least one of the plurality of
3 position indication signals indicates the presence of
4 conductive objects.

1 27. The method of claim 23 further comprising
2 determining, calculating, and monitoring the chi-squared value
3 for a plurality of frequencies.

1 28. The method of claim 27 wherein the detection of a
2 change in a chi-squared value at a particular frequency range
3 can indicate the presence of a particular type of conductive
4 objects.

1 29. The method of claim 28 wherein the particular
2 frequency range is a mid-frequency range.

1 30. The method of claim 28 wherein the particular
2 frequency range is a low-frequency range.

1 31. The method of claim 28 wherein the particular
2 frequency range is a high-frequency range.

1 32. The method of claim 28 further comprising
2 determining the position indication signal in a frequency
3 range that is not affected by a particular type of conductive
4 object.

1 33. A method comprising:
2 measuring characteristics of a conductive object;
3 determining an eddy current phase based on the
4 characterization;
5 measuring a disturbed amplitude; and
6 calculating an undisturbed amplitude based on the eddy
7 current phase, an undisturbed sensor phase, and the disturbed
8 amplitude.

1 34. The method of claim 33 wherein measuring
2 characteristics of a conductive object includes:
3 moving the conductive object in the vicinity of a
4 stationary sensor; and
5 collecting a set of disturbed data points.

1 35. The method of claim 33 further comprising
2 compensating a position indication based on the calculated
3 undisturbed amplitude.

1 36. The method of claim 33 wherein a numerical method is
2 used to solve a set of equations.

1 37. The method of claim 33 wherein a closed form solution
2 is used to solve a set of equations.